



Military Operations Research Society Workshop Outbrief:

Tackling the Space Community's Analytical Challenges

**26 - 28 February 2002
Colorado Springs, Colorado**

Workshop Summary

- ◆ **Conducted 26-28 February 2002**
- ◆ **Colorado Springs MITRE & Aerospace Facilities**
- ◆ **117 Attendees**
 - **55 New to MORS**
 - **17 “Expired” Members**

Bring the Analysis Community's Techniques to Bear on the Space Community's Challenges

Workshop Objectives

- ◆ **Analytical Methods:** What methods and approaches are available to quantify the benefits space offers to CinCs conducting a broad array of operational missions? What does space bring to the fight?
- ◆ **Analytical Tools:** How can analytical tools be updated to include valid representations of space systems, together with their contributions and limitations?
- ◆ **Operational Methods:** What specific methods or tools should be recommended to approach the space community's operational challenges?
- ◆ **Sustainment Methods:** What analytic methods could be applied to the space ground system sustainment issues to increase operational availability while decreasing overall life cycle costs?

Workshop Flow

◆ Plenary Session

- LTG Edward Anderson, Deputy USCINCSpace
- Dr. David Finkleman, USSPACECOM Chief Scientist
- BGen Russell Anarde, HQ AFSPC/XP
- COL David Ifflander, G3, Army Space Command

◆ Four Working Groups

- Analytical Methods, Steve Friedman & Mike Garrambone
- Analytical Tools, Mark Reid & Tom DeLaCruz
- Operational Methods, Dr. Lee Lehmkuhl & Lt Col Steve Baker
- Sustainment Methods, Lt Col Suzanne Beers & Maj Brent Barber

◆ Working Group Outbriefs

Senior Leadership Messages

- ◆ **LTG Anderson...Enable Decision Superiority**
 - Quantify Space and Computer Network Operations Benefits to CINC's Objectives in Operational Planning
- ◆ **Dr. Finkleman...Space in All Future Conflicts**
 - Assess Diverse Means of Mission Accomplishment
- ◆ **BGen Anarde...New Operations & New Questions**
 - What to Buy, Where to Employ, How to Integrate into Total Force
- ◆ **COL Ifflander...Knowledge-Based Force Dominates**
 - Educate Soldiers and Decisionmakers on Employment & Show Effects on Ground Forces

WG#1: Analytical Methods

◆ Objectives

- Develop/Refine an Analysis Framework for Quantifying Utility of Space
- Evaluate Current Methods and Metrics
- ID Deficiencies / Recommend Improvements

◆ Working Group Approach: Broke into Subgroups to Assess Space Mission Areas in Operational Context

- Force Enhancement: Nav, Comm, C2
- Force Enhancement: Environmental Monitoring, Surveillance & Threat Warning
- Space Control
- Information Operations

WG#1: Results

- ◆ **Concluded Adequate Methods Exist for Some**
 - Navigation, (aspects of) Space Control
- ◆ **Not For Others**
 - Communications, Command and Control, Environmental Monitoring, and Surveillance and Threat Warning
- ◆ **Measures of Merit Exist, But Linkages Don't**
 - Horizontally Across Levels of Evaluation
 - Vertically Across Mission Areas
- ◆ **“Military Utility of Space” Means Different Things to Different People**

WG#1: Recommendations

- ◆ **ASAC Champion Data Repositories and Lessons Learned Database**
- ◆ **USSPACECOM Champion Joint Analysis... Break Down the Stovepipes**
- ◆ **MORS Foster Opportunities for Sharing Basic Research on Joint “Physics of Effects” Space Topic Areas Through its Working Groups and Planned Meetings**

WG#2: Analytical Tools

- ◆ **Objective: Recommend a Deliberate Process to Identify and Assemble a Set of Credible Tools to Represent Space Capabilities and Functionality Throughout the Joint Community**
- ◆ **Working Group Approach:**
 - **Identify Space & CNO Capabilities and Functionality**
 - **Define Process to Identify a Set of Analytic Tools That Accurately Represent Space Assets**
 - **Define Process to Manage the Space Analysis Toolkit**

WG#2: Observations

- ◆ **Issue of Space Representation is at the Multi-system (Macro) Level**
- ◆ **AF & ASAC Have Had Successful Experiences in Creating Toolkits...Worthy of Emulation**
- ◆ **Need Better Cross Representation of Space/CNO/Air/Land/Sea... Capabilities Across the DoD MS&A Community**
- ◆ **OR Community Has an Information Sharing Problem**
- ◆ **Need More Participation in Existing M&S and Data Repositories**
- ◆ **Insufficient Number of Users Groups With Established Configuration Management and Sustainment Procedures**
- ◆ **Need Better Training, Retention, and Supply of Space Ops-experienced Analysts**

WG#2: Recommendation

- ◆ **Implement a Process to Develop Space Toolkit**
 - **Identify Types of Decisions Toolkit Will Support**
 - **Identify Capabilities That Space Systems Provide to Be Captured by Toolkit**
 - **Identify Measures of Merit Which Tools Will Address**
 - **Identify Current Capabilities (Census of Community's Tools)**
 - **Assess Current Capabilities With Criteria #1-#3 to Admit to Toolkit**
 - **Identify Capabilities That Must Be Represented**
 - **Derive Shortfall List**
 - **Prioritize Needs, Build Investment Plan**
 - **Build New Capabilities As Required**
 - **Admit/remove New Tools As Required**

WG#3: Operational Methods

- ◆ **Problem Statement: The scheduling of AFSCN ground systems is ripe for the application of operations research methods. What specific methods or tools should be recommended?**
- ◆ **Working Group Approach**
 - Discuss Current State of AFSCN Scheduling
 - Review Past Automated Scheduling Efforts
 - Refine Problem
 - Recommend Organizational, Technical, and Infrastructure Improvements

WG#3: Results

- ◆ **Current System Is Accomplishing the Current Mission**
- ◆ **Future Mission Will Outstrip Infrastructure, Including Scheduling**
- ◆ **No Formal Mission Scheduling Prioritization System**
- ◆ **Organizational Issues Dominate Technical Issues**
- ◆ **Need to Build Compelling Case for System-wide Improvement**
 - **Demanded by Government Satellite Control Network**
 - **Systems Approach Versus Piecemeal, Band-aid Approach**
- ◆ **AFSCN *Planning Needs* Are Ripe for Analytical Methods**

WG#3: Recommendations

- ◆ **Organizational: Implement Centralized Control**
- ◆ **Infrastructure: Evolve AFSCN to GSCN**
 - Implement Commercial “Best Practices” and Integrated Systems Approach
- ◆ **Technical: Analytical Support to Planning Process**
 - Data and Constraints
 - Planning Models
 - » Demand Forecasting, Capacity Allocation, Ground Architecture Planning, Service Request Simulation, Scheduling Model, Cost Modeling
 - Prioritized Optimization for Planning and Scheduling

WG#4: Sustainment Methods

- ◆ **Objectives**

- **Develop Means for Applying Analytical Techniques to Sustainment Practices for Space Ground Systems**

- ◆ **Working Group Approach:**

- **Reviewed Current Practices in AFSCN Sustainment**
 - » **“Run to Failure”**
 - » **Periodic Maintenance & Limited Diagnostics**
 - **Reviewed “State of the Art”**
 - » **Logistics Analysis Tools**
 - » **Condition Based Maintenance/Logistics**
 - » **Prognostics**
 - » **Optimization**
 - » **Supply Chain Optimization**

WG#4: Results

- ◆ **AFSCN is Faced with Two Stage Issue**
 - Sustainment of Current, Aging Network
 - New Antennas' Design for Sustainment
- ◆ **Optimization Techniques Can Be Applied to Current RM&A Data to Refine Decisionmaking**
 - Legacy: Maintenance & Mod/Retrofit Planning
 - Replacement: Reliability Allocation, Design Trades, Spares Inventories
- ◆ **CBM/CBL/Prognostics Can Be Designed Into New System Through Systematic Application to Legacy System**

WG#4: Recommendations

- ◆ **Building Block Approach**
 - Analyze System
 - Develop Methods and Algorithms
 - Select Testbed Site
 - Implement and Iterate
- ◆ **Applicable Techniques**
 - CBM
 - CBL
 - Prognostics
 - Optimization

Synthesis Group...Common Themes

- ◆ **Space Operations Offer Many Opportunities to Apply OR Analysis Methods and Techniques**
 - Available OR Methods Can Be Applied to the Issues
 - Lack of Application in the Past Appears to be More a Matter of Focus Than Capability
- ◆ **Space Operations Analysis Has a Much Shorter History Than Ground, Sea or Air Analysis**
 - From an OR Perspective, Space is Not Unique
 - » Offers a Combination of Technologies and Military Contributions That Haven't Been Completely Quantified
 - » Can Be Effectively Examined by OR Techniques

Synthesis Group...Common Themes

- ◆ **Space Offers a Collection of Specific Capabilities (With Some Unique Features)**
 - Impact Needs to Be Assessed
 - Not Necessarily Modeled Well Today
- ◆ **Working Groups Focused on “Roadmaps” for Applying OR to These Contemporary Space Problems**
- ◆ **Different Constituencies, Different Concerns, Different Perceived Needs in Each Working Group**

Conclusion

- ◆ **Underlying Theme \Rightarrow Use OR Techniques to Better Quantify the Impact of Space Ops**
- ◆ **In the Process \Rightarrow Methods and Tools Need to Comprehensively Account for ALL Military Capabilities and ALL Analysis Purposes**
 - Air, Ground, Sea, AND Space
 - Planning, Acquisition, and Warfighting
- ◆ **Space as Integral Part of the Ops Equation \Rightarrow Enhance Space Analysis and Make Results More Useful to Acquisitions and Operations**

Summary

- ◆ **Well Attended Workshop...**
- ◆ **Succeeded in Bringing Analysis and Space Communities Together**
- ◆ **Each Working Group Made Progress**
- ◆ **Suggest a Follow-on Workshop Focused on Computer Network Operations**